Technical Disclosure Commons

Defensive Publications Series

July 13, 2017

Using the Least Congested Path for Non-minimal Load-balanced Routing (LCP)

Nicholas George McDonald

Hewlett Packard Enterprise

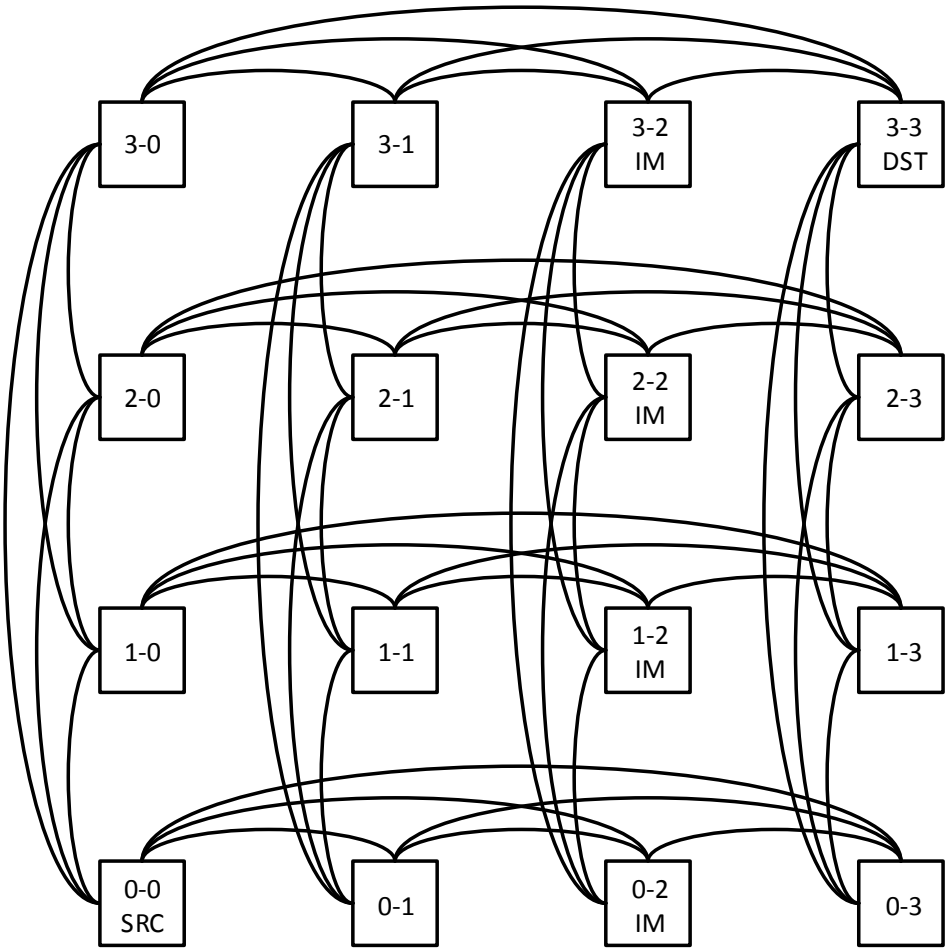
Using the Least Congested Path for Non-minimal Load-balanced Routing (LCP)

Abstract:
The most popular non-minimal adaptive routing algorithms (namely UGAL) decide at the source router whether to route minimally to the destination or to route minimally to a randomly chosen intermediate node then minimally to the destination. The random intermediate selection implements Valiant's randomized routing which provides perfect load balancing, albeit at a reduced injection rate. In contrast, this methodology chooses the intermediate node to be a router that lies on the least congested output path of the current router.

Methodology:
Choosing intermediate nodes randomly provides steady-state statistical load-balancing, however, random collisions happen frequently. When multiple random decisions collide, the symptom in the network is temporary congestion which leads to higher latency and lower throughput. This methodology removes the randomness as part of the intermediate node selection and replaces it with a least congestion path selection.

When choosing an intermediate node for non-minimal routing, instead of choosing randomly this methodology chooses the intermediate node that contains the least congested path. When the routing function determines it needs to route non-minimally, it simply chooses the output port with the least congestion that faces another router. It then selects the intermediate node randomly among the nodes that lie on that least congested output path. The style of selection can be fully random (like Valiant's routing) or can use optimizations like CLOS-AD (only select within the unaligned dimensions) or source ancestor (those nodes one hop away from the source node).

The following figure show how this works. The packet is in router 0-0 and wants to get to router 3-3. The routing algorithm is using XY dimension order routing and the least congested output port is the port that connects 0-0 to 0-2. As shown, 0-2, 1-2, 2-2, and 3-2 are all acceptable intermediate node selections.



Special note about source ancestor selection when using LCP:
In terms of source ancestor routing, this provides optimal behavior since it is using the path that has previously been used the least. This guarantees local load-balancing. This also has the benefit of not forcing the packet to carry an intermediate node address.

The main advantage to this methodology is that it removes that effect of collisions caused by independent random number generators. This reduces the latency in the network and increases the achievable throughput of the network.

Disclosed by Nicholas George McDonald, Hewlett Packard Enterprise